

**ROBUST REINFORCED PACKAGING SYSTEM FOR
LIFTING AND DISPENSING OF DRY POWDER MATERIALS**

[001] This application claims priority from U.S. Provisional Patent Application No.
5 63/547,494, filed on November 6, 2023, which is incorporated herein in its entirety.

FIELD OF THE INVENTION

[002] The present invention is a packaging system with improved strength that maintains
the physicochemical integrity of its contents, free-flowing characteristics. In particular, the
present invention relates to thin film packaging systems with reinforced walls that can hold
10 heavy loads of dry powder materials without rupturing.

BACKGROUND OF INVENTION

[003] Current methods to attach an inner liner to an outer liner of a Direct Dispense bag (and
other flexible intermediate bulk containers (FIBCs)) use grommets (typically four on the top
and four on the side) with zip ties on the top and the side sections of the bag or by stitching
15 together the edges of the liners. For grommeted FIBCs, the zip-ties hold the inner liner and
outer liner together during filling and dispensing of the bag. In these FIBC designs, the weight
during filling and dispensing can be concentrated on the top and side grommets of the bag
resulting in localized forces, which can cause tearing of the grommets from the liners. For
medium sized stitched FIBCs, the inner liner frequently tears away from the outer liner along
20 the line of stitches (i.e., the sewn areas), when the bag is filled with more than 100 kg of
material.

[004] Therefore, there is a need for a direct dispensing bag/FIBC with a reinforced connection between the inner liner and the outer liner that prevents tearing and spillage under maximum stress during filling and dispensing operations.

SUMMARY OF THE INVENTION

5 [005] In accordance with the present invention, a direct dispensing bag with a reinforced attachment of an inner liner to an outer liner is provided. More specifically, the invention is a robust reinforced packaging system for lifting and dispensing dry powder materials that includes an inner liner, a reinforcing tape, preferably a bi-directional reinforcing tape, and an outer liner. The inner liner includes a single layer or a multilayer sheet of polyethylene,
10 polypropylene, polyamide, EVA or EVOH and has a longitudinal dimension, a transverse dimension, a top end, a bottom end, and a plurality of longitudinal and transverse edges, preferably four of each. Preferably, the multilayer sheet of the inner liner consists of one or more layers of polyethylene and a layer of EVA or EVOH.

[006] The bi-directional reinforcing tape includes a bi-directionally oriented polyethylene,
15 polypropylene, or polyamide layer and an adhesive outer layer, wherein the bi-directional reinforcing tape is applied to the longitudinal and/or transverse edges of the inner liner. The outer liner includes a single layer or a multilayer sheet of polyethylene, polypropylene, polyamide, EVA or EVOH and has a longitudinal dimension, a transverse dimension, a top end, a bottom end, and a plurality of longitudinal and transverse edges, preferably four of
20 each. In preferred embodiments, the outer liner is a single layer of polypropylene. After the reinforcing tape is applied to the longitudinal and/or transverse edges of the inner liner, the outer liner is placed over the applied reinforcing tape on the inner liner with the longitudinal

edges of the inner liner and the outer liner aligning. The longitudinal edges of the inner liner are then attached to the longitudinal edges of the outer liner by a plurality of stitches, heat welding or using an adhesive, preferably by a plurality of stitches. The packaging system can also include a window in the inner and outer liners that allows the contents of the

5 packaging system to be identified.

[007] The top end of the inner liner of the robust reinforced packaging system includes a sealable opening and the bottom end of the inner liner includes a closure port for dispensing the dry powder materials. When the sealable opening is sealed and the closure port is in the closed position, a confined interior space is formed by the inner liner. One or more

10 desiccant packets can be attached to an interior surface of the inner liner to absorb any moisture in the confined interior space. In preferred embodiments of the packaging system, a webbing loop or strap is attached to one or more of the plurality of longitudinal edges of the outer liner. The webbing loops or straps are used for lifting and hanging the packaging system when transporting, storing and/or dispensing.

15 **BRIEF DESCRIPTION OF THE FIGURES**

[008] The preferred embodiments of the reinforced dispensing bag of the present invention, as well as other objectives, features and advantages of this invention, will be apparent from the accompanying drawings wherein:

[009] FIG. 1 is a side perspective view of an embodiment of the reinforced dispensing bag

20 with the outer liner installed over the inner liner.

[010] FIG. 2 is a side perspective view of an embodiment of the inner liner of the dispensing bag with reinforcing tape applied to the longitudinal edges.

[011] FIG. 3 is a side view of an embodiment of the dispensing bag.

DETAILED DESCRIPTION OF THE INVENTION

5 [012] The robust reinforced packaging system provides a durable direct dispensing bag with a reinforced attachment of an inner liner to an outer liner. More specifically, the invention is a strength enhancement for attaching the inner liner to the outer liner of the bag that: a) reinforces the multiple film layers of the bag, b) improves bag integrity, and c) improves the flow of dry powder materials during dispensing by balancing the weight
10 distribution of the material in the bag. The attachment is done by adhesively applying a fiberglass reinforced plastic layer along the longitudinal and/or transverse edges between the inner liner and the outer liner. This also allows thinner liners to be used in the bag which reduce the risk of releasing extractables/leachables from the packaging into the product.

[013] The present invention is a reinforced dispensing bag for lifting and dispensing dry
15 powder materials. The dispensing bag uses a reinforcement method for attaching the inner liner to the outer liner of the packaging system to evenly distributes the stress caused by the weight of the material. This is accomplished by applying fiberglass reinforced plastics, preferably in the form of a bi-directional tape, along the longitudinal and/or transverse edges of the inner liner before it is attached to the outer liner. Preferably, the inner liner has a
20 longitudinal dimension and a transverse dimension and has edges extending along one or more of the edges in the longitudinal direction and/or one or more of the edges in the transverse direction.

[014] The increased strength of the attachment of the inner liner to the outer liner is achieved in part by applying a bi-directional oriented fiberglass reinforced specialty tape layer to the edges, preferably four edges as shown in FIG. 2), of the inner liner of the packaging system prior to the outer liner being attached to the inner liner. This design is preferably used with
5 liners in the thickness range of 50-microns to 250-microns. The inner and outer liners can be a single layer or a multilayer sheet of polyethylene, polypropylene, polyamide, ethylene vinyl acetate (EVA) and/or ethylene vinyl alcohol (EVOH). EVA and EVOH are preferably used as oxygen barrier layers in multi-layer sheets that are used to form the liners, preferably the inner liner. The liners can have additives included for processing and end-user functionality like
10 anti-static agents, anti-slip agents and anti-block agents.

[015] The inner liner of the packaging system is reinforced by applying a reinforcing tape, preferably a bi-directional plastic tape, to one or more of the edges of the liner extending in a longitudinal or transverse direction, preferably the longitudinal direction. The bi-directional tape is reinforced with continuous glass yarns in both the longitudinal and
15 transverse direction along with a biaxially oriented polypropylene backing. The polypropylene backing of the tape provides good abrasion, moisture and scuff resistance. The adhesive is selected to provide good adhesion to a wide variety of surfaces including plastic, specifically to the material used to form the inner liner. Commercially available bi-directional tapes that can be used are 3M 8969, Intertape 745, JVCC 762-BD, T.R.U. FIL-
20 835B/D, Tesa 4591, and equivalents. Other tape types that can be used include bi-directional and mono-directional reinforced filament tapes made from polypropylene, polyethylene, and polyamide. Tapes can be applied to single or multiple sections of the inner liner for

reinforcement. Reinforcement can be local or throughout all of the locations where the inner liner is heat sealed.

[016] The bi-directional continuous glass yarn tape protects the packaging system from the transmission of shear and impulse forces along the longitudinal and transverse directions. The
5 glass fibers also allow the stitching that attaches the inner liner to the outer liner to be robust and prevents localized imperfections from propagating during use of the packaging system.

[017] The adhesive layer on the tape allows non-product contact application on the outward side of the inner liner, while providing excellent cross-direction tensile strength. When the bag is filled with a material, its weight is evenly distributed along the edge of the packaging system
10 where the outer liner is attached, preferably sewn, to the inner liner with the bi-directional continuous glass yarn tape or thread. This prevents any localized shear and tensile forces from impacting the packaging system structure and liner integrity.

[018] The reduction of localized stress in the liner also allows the packaging system to deploy with fewer creases and folds, which improves dispensing performance and reduces dispensing
15 time. The outer liner can be attached to the inner liner by stitching, using an adhesive or by any of several well known heat welding methods.

[019] A window in the side wall of the packaging system allows the contents to be identified using a Raman spectrometer, without having to open the packaging system and directly access the materials inside.

20 [020] The reinforced dispensing bag packaging system is now described with reference to FIGs. 1 - 3. FIG. 1 shows an embodiment of the packaging system 10 having four

longitudinal side edges with an outer liner 12 attached over an inner liner 14. An opening 16 at the top of the inner liner 14 is used to fill the packaging system 10. After the packaging system 10 is filled, a zip tie or some other well known means (such as heat welding) is used to seal the packaging system 10. A zip tie and/or a closure port 18 and/or a dust cap 20 at the bottom of the inner liner 14 is used to seal the dispensing port 19 of the packaging system 10 during transportation and storage. Webbing loops or straps 24, 25, 26, 27 are optionally attached to each of the four edges of the packaging system 10 for lifting and/or hanging the packaging system 10. A window 28 in the side of the packaging system 10 allows the contents to be viewed through the outer and inner liners 12, 14 and allows the materials inside to be identified using a Raman spectrometer.

[021] FIG. 2 shows the inner liner 14 before the outer liner 12 is attached. A reinforcing tape 30 (preferably a bi-directional tape) is applied over the exterior longitudinal edges of the inner liner 14. In some embodiments, the bi-directional tape 30 is also applied to the transverse edges of the inner liner 14. A plurality of desiccant packets 32 are attached to the interior surface of the inner liner 14 to absorb any moisture inside the inner liner 14 to prevent dry power materials from clumping and preventing the materials from being easily dispensed from the packaging system 10. The packets 32 are formed by a sheet of polyethylene, preferably low density polyethylene, and a sheet of permeable material, preferably Tyvek, that are filled with desiccant and heat welded around the edges. The packets 32 are attached to the interior surface of the inner liner 14 by heat welding the polyethylene side of the packets 32 to the inner liner 14. The side of the packet 32 with the sheet of permeable material allows moisture to pass through and be absorbed by the desiccant.

[022] FIG. 3 shows a side view of the packaging system 10 that includes an outer liner 12 and an inner liner 14. The top of the inner liner 14 has an opening 16 for filling the packaging system 10 with materials. The bottom of the inner liner 14 has an outlet 19 for dispensing the materials. When the packaging system 10 is stored or transported, the dispensing port 19 is sealed by a closure port 18 and a dust cap 20. Webbing loops or straps 24, 25, 26, 27 are located on each of the four edges of the packaging system 10 for lifting and hanging the packaging system 10. A window 28 is located in the side of the packaging system 10 that can be used for identifying the contents using a Raman spectrometer.

EXAMPLES

10 [023] The examples set forth below serve to provide further appreciation of the invention but are not meant in any way to restrict the scope of the invention.

[024] A reinforced bag using this design can be filled up to 170 kg with no sign of tearing along the stitch. After filling and dispensing the material from the same bag three times, the bag remained intact with no sign of deterioration along the stitch. With an extended lift
15 duration of 24 hours, no weakening or damage of the reinforcement or liners was observed.

[025] Thus, while there have been described the preferred embodiments of the present invention, those skilled in the art will realize that other embodiments can be made without departing from the spirit of the invention, and it is intended to include all such further modifications and changes as come within the true scope of the claims set forth herein.

We claim:

1. A robust reinforced packaging system for lifting and dispensing dry powder materials, the packaging system comprising:
 - an inner liner comprising a single layer or a multilayer sheet and having a longitudinal dimension, a transverse dimension, a top end, a bottom end, and a plurality of longitudinal and transverse edges;
 - a reinforcing tape, wherein the reinforcing tape is applied to the plurality of longitudinal edges of the inner liner; and
 - an outer liner comprising a single layer or a multilayer sheet and having a longitudinal dimension and a plurality of longitudinal edges,wherein the outer liner is placed over the inner liner with the longitudinal edges of each the inner liner and the outer liner aligning, and wherein the longitudinal edges of the inner liner with the applied reinforcing tape are attached to the longitudinal edges of the outer liner.
2. The robust reinforced packaging system according to claim 1, wherein the inner liner comprises polyethylene, polypropylene, polyamide, ethylene vinyl acetate (EVA) and/or ethylene vinyl alcohol (EVOH).
3. The robust reinforced packaging system according to claims 1 and 2, wherein the outer liner comprises polyethylene, polypropylene, polyamide, EVA and/or EVOH.
4. The robust reinforced packaging system according to any of claims 1 through 3, wherein the reinforcing tape is a bi-directional reinforcing tape comprising a bi-directionally

oriented polyethylene, polypropylene, or polyamide layer and an adhesive outer layer.

5. The robust reinforced packaging system according to any of claims 1 through 3, wherein the reinforcing tape is a bi-directional or a mono-directional reinforced filament tape comprising polypropylene, polyethylene, and polyamide.

6. The robust reinforced packaging system according to any of claims 1 through 5, wherein the longitudinal edges of the inner liner are attached to the longitudinal edges of the outer liner by stitching, heat welding or using an adhesive.

7. The robust reinforced packaging system according to any of claims 1 through 6, wherein the plurality of edges of the inner liner are attached to the plurality of edges of the outer liner by a fiberglass reinforced plastic layer.

8. The robust reinforced packaging system according to any of claims 1 through 6, wherein the plurality of edges of the inner liner are attached to the plurality of edges of the outer liner by a plurality of stitches.

9. The robust reinforced packaging system according to any of claims 1 through 6, wherein the plurality of edges of the inner liner are attached to the plurality of edges of the outer liner by heat welding or using an adhesive.

10. The robust reinforced packaging system according to any of claims 1 through 9, wherein the top end comprises a sealable opening, and wherein the bottom end comprises a

closure port for dispensing the dry powder materials.

11. The robust reinforced packaging system according to any of claims 1 through 9, wherein the top end of the inner liner comprises a sealable opening, and wherein the bottom end of the inner liner comprises a closure port having an open position and a closed position for dispensing the dry powder materials, and wherein, when the sealable opening is sealed and the closure port is in the closed position, a confined interior space is formed by the inner liner.

12. The robust reinforced packaging system according to any of claims 1 through 11, wherein a webbing loop or strap is attached to one or more of the plurality of longitudinal edges of the outer liner.

13. The robust reinforced packaging system according to any of claims 1 through 12, wherein the plurality of inner longitudinal edges consists of four longitudinal edges and the plurality of outer liner longitudinal edges consists of four longitudinal edges.

14. The robust reinforced packaging system according to any of claims 1 and 3 through 13, wherein the multilayer sheet of the inner liner consists of one or more layers of polyethylene and a layer of EVA or EVOH.

15. The robust reinforced packaging system according to any of claims 1, 2 and 4 through 14, wherein the multilayer sheet of the outer liner is a single layer of polypropylene.

16. The robust reinforced packaging system according to any of claims 1 through 15,

further comprising a window in the inner and outer liners that allows the contents of the packaging system to be identified.

17. The robust reinforced packaging system according to any of claims 1 through 16, wherein one or more desiccant packets attached to an interior surface of the inner liner.